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A Review and Design of Bore well Rescue Robot

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Abstract. In recent years, there has been an increase in the bore well mishaps wherein children fall into open bore wells. This project aims at designing a system which is capable of rescuing the child with ease and without causing any discomforts such as scratching to the walls of the well. The system is a lightweight, a compact arrangement that has a cable rope to which a deflated air bag is tied, which goes beyond the depth of struck and is inflated. The system is controlled by a rotating rope drum and a cable rope. The design of the system is adaptable to the diameter of the bore well which varies from 4 inches to 12 inches. The Depth of Struck and Posture of Struck of the child is monitored through camera using live detector. The project is intended to reduce the time taken to rescue and risk involved in the operation. These bore wells in turn have started to take many innocent lives. Bores which yielded water and subsequently got depleted are left uncovered. Small children without noticing the hole dug for the bore will and slip in. There is no proper technique to rescue victims of such accidents. When the make shift local arrangements do not work. In most cases reported so far, a parallel hole is dug and then horizontal path is made to reach to the subject's body. It is not only a time taking process, but also risky in various ways.

1. Introduction

Rescuing these trapped children is both difficult and risky for everyone involved with the operation. Evan a small delay in the rescue can cost the child's life. Additionally, lifting the child out of the narrow confines of the bore wells is a tedious task. Victims often suffer trauma from the fall, either in the form of physiological trauma from being placed highly in the restricted environment over many hours. The Bore Well Rescue System offers a solution to these challenges. In order to meet the ever-increasing demand for water for industrial, agricultural and commercial purposes, bore wells are dug. With the huge increase in activities, groundwater is not available at all places. This increases the number of bore wells with which water is obtained from aquifers present in the lower surfaces of the ground. Most bore wells that are constructed for the pure of water extraction are found in areas where there is a human activity, and some of these are unsuccessful in yielding any groundwater. These bore wells are often left open which has been known to be hazardous to human life. The mouths of these constructions are often covered only with polythene sacks or brittle blocks of cement, which are never adequate measures for sealing a potentially hazardous hole in the ground. Children of very tender age tend to fall into these open bore wells and get trapped. The machine has a cable rope to which a deflated air bag is tied, which goes beyond the depth of struck and is inflated. The system is controlled by a rotating rope drum, a cable rope, and an air bag. The design of the system is adaptable to the diameter of the bore well which varies from 4 inches to 12 inches. The Depth of Struck and Posture of Struck of the child is monitored through camera using live detector. The project is intended to reduce the time taken to rescue and risk involved in the operation. The project is inclined towards the rescue process, which is technique oriented. The Depth of Struck and Posture of Struck play a key role in the rescue operation, obtained by the Camera interfaced with the live detector. Uninterrupted supply of oxygen is provided so as to eliminate any respiratory issues. Upon determination of Depth of Struck & Posture of Struck, the deflated air bag is sent to a depth beyond and inflated. Upon inflation, cable rope is raised so as to bring the air bag to and it is ensured that the trapped child is seated on the air bag comfortably. Using Air bag, the child's body is locked tightly. The entire sandwiching system is raised gradually so as to ensure safer lifting. The Air bag used in the system can bear up to a weight of 15 Kilograms. The raising & dropping are done by the Rotating Rope Drum, driven by a Motor. The Compressed air is obtained from additional Air Compressor, with which air bag works. The lift operation is monitored by the camera.

2. Methodology of Bore Well Rescue Robot

In order to meet the ever-increasing demand for water for industrial, agricultural and commercial purposes, bore wells are dug. With the huge increase in activities, groundwater is not available at all places. This increases the number of bore wells with which water is obtained from aquifers present in the lower surfaces of the ground. Most bore wells that are constructed for the pure of water extraction are found in areas where there is a human activity, and some of these are unsuccessful in yielding any groundwater. These bore wells are often left open which has been known to be hazardous to human life. The machine has a cable rope to which a deflated air bag is tied, which goes beyond the depth of struck and is inflated. The system is controlled by a rotating rope drum, a cable rope, and an air bag. The design of the system is adaptable to the diameter of the bore well which varies from 4 inches to 12 inches. The Depth of Struck and Posture of Struck of the child is monitored through camera using live detector. The project is intended to reduce the time taken to rescue and risk involved in the operation. The project is inclined towards the rescue process, which is technique oriented. The Depth of Struck and

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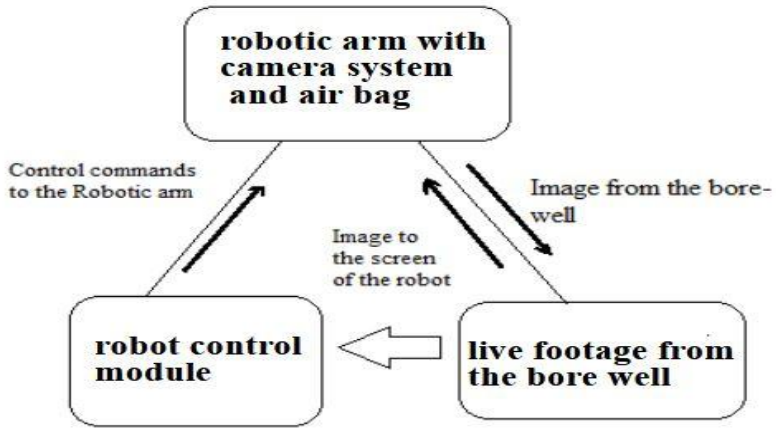
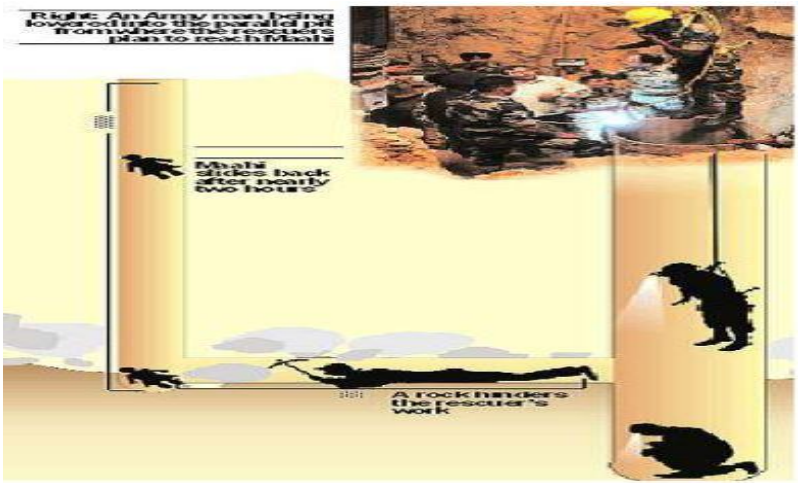


Data flow diagram of the system

3. Existing System

The Common method used to find the depth of a child is with the help of a rope. In normal rescue operation carried out by the Army and National Disaster Rescue Force Teams, a pit is dug parallel to the bore well close to the depth of the child. Then a horizontal path is created to connect the location of the child is caved through. A small delay in the accumulation of different resources for the rescue operation in the existing method will cost the life of an infant. If the area beside the borehole contains rocks below a certain depth, in such cases the chance of saving the child alive is very low. Lack of oxygen inside the bore well and lack of light sources causes the major difficulty during the rescue operation. There is no special equipment for rescuing the child trapped inside the bore well. Not even a proper technique to rescue victims of such accidents. The time taken for the operation is more than 72 hours in most of the cases. Following are some of the details of the bore well mishaps in recent years in India. The following is a list of Bore Well Mishaps occurred in the recent years in different states of the country.



S.No	Name of Child	Age	Place of Incident	Status
1	Ms.RMadhumitha	3	VillupuramDist, Tamil Nadu	Recovered, Died in Hospital
2	Mr. Radheshyam	2.5	Churu Dist, Jaipur	Died in Hospital
3	Mr. Chotu	9	Karauli Dist, Rajasthan	Not alive
4	Ms. Tanu	4	Palwal, Haryana	Alive
5	Ms. Muthulakshmi	7	Suryapalli Village, Tamilnadu	Died in Hospital
6	Mr. Ajith	5	Karim Nagar, Andhra Pradesh	Not alive
7	Ms. Mahi	5	Gurgaon	Not alive
8	Mr. Ankit	4	Raimalpura Village, Kochi	Not alive
9	Mr. Tirumalesh	1	Mahbubnagar,Andhrapradesh	Not alive
10	Ms. Asmita	1	Rajkot, Gujarat	Not alive
11	Mr. Om Santosh Devre	1.5	Nashik, Maharashtra	Not alive

4. Proposed System

This work is aimed at fabrication of a rescue system to work in bore well rescue operations. The system consists a deflated air bag and surveillance camera with live detection. The mechanism takes hold of the child's body and lifted up gradually. An entire rescue operation is a process-based approach. Operation begins with determining the Depth of Struck along with the Posture of Struck of the child, obtained by the surveillance camera interfaced with live detection facility. Upon determining both Depth of Struck and Posture of Struck from the camera, the deflated air bag fitted into the cable is passed beyond the Depth of Struck to some extent. As first the robot will be implemented hanging inside the bore-well with the help of ropes. After reaching a certain distance from the victim the robot will be stopped for deciding the pick-up position as we can see the whole view of the bore-well. The whole scenario will be feeded live through the communication module which will publish the images from the cameras of the robot. The family members of the victim can also see the condition through images being published by the high resolution cameras upon reaching that depth, compressed air is sent through the cable so as to inflate the air bag at that depth to ensure that the baby does not go deep any further as shown.

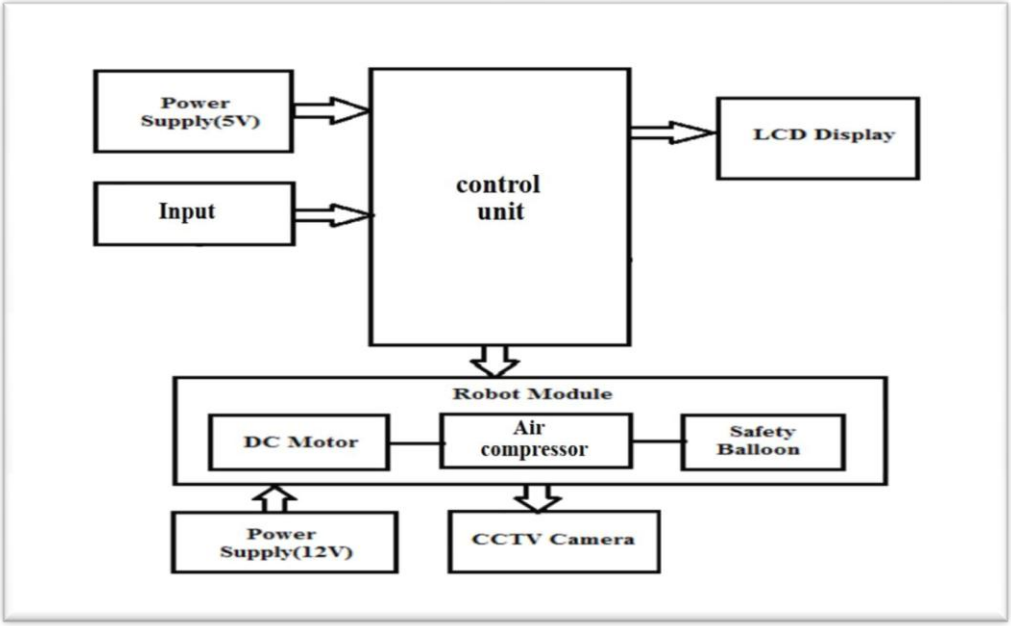
5. Overview of Proposed System

- Determination of Depth of Struck and Posture of Struck from Wireless camera interfaced to any Tablet, PC or Mobile Phone.
- Uninterrupted supply of Oxygen to the child to nullify any respiratory issues.
- Passing deflated air bag using a cable beyond Depth of Struck.
- Inflating the air bag using compressed air, through cable so as to allow the air bag to occupy the entire area of the bore well below the Depth of Struck.
- Ensuring that the child is seated safely on the air bag upon raising the inflated air bag till Depth of Struck.
- Lowering both Air bag and Holding Attachment assembly to reach the Depth of Struck.
- Expansion of air bag to occupy the area, so the holding attachment.
- Acquisition of Data from Camera regarding the possibility of hold and separation between the heights of the child and the attachment.
- Holding the child tight upon attaining constrained conditions.
- Raising the child held in the attachment slowly to ensure no collision with the side walls of the bore well. The proposed technique can be better understood from the following figure. Cable passing the child beyond Inflation of Air bag holding the child tight

6. Working of Model

The rope is connected to the top of the robot. As the robot is sent into the bore-well hole, electric wires for the motor from the control unit is attached along the rope. The pump hose is fixed to the upper plate of the robot. Depending on the robot movement, the hose length is adjusted from outside the bore-well. Using the special features of the camera, the baby position is seen through a computer. At the appropriate position, the lowering arm will go into the bore-well wall using the motor connected to the pcb controller setup on the upper plate. If the baby is trapped in the middle of bore-well, using the hollow tube, the safety balloon gas tube is in the gap between bore-well and the baby. Initially the air tube is above the end of robot hands. It will avoid stabbing of air tube on the baby. Then the robot is moved down in such a way that the robot hands free to hold the baby head or middle of the body. Then the safety balloon is inflated by using the air compressor through vacuum pump. The camera is placed below the lower disc. After the safety balloon reached the exact pressure, the pump/vacuum supply is cut off. Then the safety balloon is moved upward using motor connected to the pulley setup till the safety balloon completely supports the baby. Now the baby is completely in robot control. The baby movements see through the lower camera. Then slowly, the baby is moved upward. By pulling the rope using the pulley control system. When the robot is

pulled out, the rope is cut off. The robot is taken outside carefully from the stand. The hands are loosened by the motor control and the baby is taken for treatment. Each and every control of the system.



7. Results & Discussion

Human life is precious. Bore well child server is a significant attempt to save the life of the victim of bore well accidents. Besides this the unique capability of climbing through vertical and inclined pipes makes wide scope of application for this machine in manufacturing industries and other relevant fields. The Bore Well Rescue System designed and fabricated thus helps in reducing the rescue operation time very effectively compared to any other technique being followed nowadays. It is also observed that the system developed is functional and plays a vital role in saving the child trapped inside a bore well without any harm. The approach thus followed is relatively better than that being adopted. Minute to minute monitoring about the child and about the status of the rescue operation is also possible. The system is designed and fabricated to rescue children weighing between 8Kg and 15 Kg. Following the general guidelines of the Permission Issuing Authority, the bore well has to be 4 inches in diameter for Commercial Applications, 6 – 8 inch for Agricultural Applications and 8 – 12 inch for Industrial and Heavy Industrial Applications. The structure is made strong enough to sustain all possible loads, though it is made flexible at the same time to adjust wider range of bore diameter and any change in the diameter of bore. In the rescuing operation time is a vital factor which alone can determine the success or failure of the whole operation. Thus, it has been designed keeping the entire obstacle in mind that may arise during the operation. We like to conclude with the help of my research project I am able to rescue without any damage.

8. Conclusion

Human life is precious. Bore well child server is a significant attempt to save the life of the victim of bore well accidents. Besides this the unique capability of climbing through vertical and inclined pipes makes wide scope of application for this machine in manufacturing industries and other relevant fields. In the current design of bore well child saver machine has been made to suit every possible situation may occur in rescuing operation. The structure is made strong enough to sustain all possible loads, though it is made flexible at the same time to adjust wider range of bore diameter and any change in the diameter of bore .In the rescuing operation time is a vital factor which alone can determine the success or failure of the whole operation. Thus, it has been designed keeping the entire obstacle in mind that may arise during the operation. We like to conclude with the help of my research project I am able to rescue without any damage. The Bore Well Rescue System fabricated thus becomes a big asset in completing the rescue operations successfully without causing any discomfort to the child in any Manner. The minute to minute monitoring, slow and steady lifting ensures the safety of the child. Support air bag provided gives support to the child and also makes sure that the child doesn't go deep any further. Rather than the technical development we would be highly satisfied if it can fulfill the most important aspect of the project, which is to save a life. In future we can use this project in several applications by adding additional components to this project. By connecting temperature sensor to the robot we can get the temperature of dangerous zones in personal computer itself instead of sending human to there and facing problems at the field, we can send robots to there and sensor will detect the temperature and it gives information to the Microcontroller and microcontroller gives the information to the transceiver from that we can get the data on the PC side. By connecting smoke sensor to the robot we can get the information related concentration of smoke or gases in respective field's i.e. (coal mines, dangerous zones, etc.) Sensors sense the information and it gives to the microcontroller and its gives to the transceiver and from that we get the information on personal computer.

Reference

[1]. Design and Development of a Bore Well Rescue Robot | Niveditha Kalavakonda et.al | The 14th IFToMM WorldCongress, Taipei, Taiwan, October 25-30, 2015. DOI Number: 10.6567/IFToMM.14TH.WC.OS13.103

[2]. Bore Well Rescue Robot | V Venmathi et.al | International Journal of Computer Applications (0975 – 8887) Volume 113 – No. 14, March 2015

[3]. Rescue Robotics in Bore Well Environment | Manish Raj et.al | Research Gate | June 2014

[4]. Bore Well Rescue Robot | Simi Simon et.al | International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 03 | Mar-2016 www.irjet.net p-ISSN: 2395-0072

[5]. Rescue Child from Bore Well using Embedded System | K V V Satyanarayana et.al

[6]. Pipeline Inspection and Bore Well Rescue Robot | Palwinder Kaur et.al | IJRET: International Journal of Research in Engineering and Technology ISSN: 2319-1163 | ISSN: 2321-7308

[7]. B. Bharathi, B. Suchitha Samuel "Design and Construction of Rescue Robot and Pipeline Inspection Using Zigbee" International Journal Of Scientific, Engineering and Research (IJSER) Volume 1 Issue 1, September 2013.

[8]. Sridhar Palaniswamy " Life Saving Machine" the first International Conference on Interdisciplinary Research and Development, 31 May-1 June 2011, Thailand.

[9]. O. Tatar, D. Mandru, "Design of in-pipe modular robotic systems", Vol.147-149, pp. 49-54, 2009.

[10]. Alan Mutka and Zdenko Kovacic "A Leg-wheel robot based approach to the solution of flipper-track robot kinematics", IEEE International Conference on Control Applications, 28-30 September, 2011, USA.

[11]. Safety balloon-Direct web search on google.com

[12]. Camera - Direct web search on google.com

[13]. J. Burke and R.R.Murphy, "Human-robot interaction in USAR technical search: Two heads are better thanone,"in Proc.IEEE Int. Workshop ROMAN, Kurashiki, Japan, 2004, pp. 307-312.

[14]. Chidambaram, P. K., Dr Amol Lokhande, Dr M. Ramachandran, Vimala Saravanan, and Vidhya Prasanth. "A Review on Biodiesel Properties and Fatty acid composites." REST Journal on Emerging trends in Modelling andManufacturing 7, no. 3 (2021): 87-93.

[15]. J. Casper and R. R. Murphy, "Human-robot interactions during the robot assisted urban search and rescue response at the world trade center," IEEE Trans. Syst., Man, Cybern. B, Cybern, Vol. 33, no. 3, pp. 367–385, Jun. 2003.

[16]. R. R. Murphy, "Activities of the rescue robots at the World Trade Center from 11–21 September 2001," in Proc. IEEE Robot. Autom. Mag., 2004, pp. 50–61

[17]. Makhal, Abhijit, Manish Raj, Karan Singh, Rajan Singh, Pavan Chakraborty, and G. C. Nandi. "ATOM-A Low-Cost Mobile Manipulator for Research and Testing." Doriya, Rajesh, Pavan Chakraborty, and G. C. Nandi.

[18]. "'Robot-Cloud': A framework to assist heterogeneous low cost robots." In Communication, Information & Computing Technology (ICCICT), 2012 International Conference on, pp. 1-5. IEEE, 2012.

[19]. Makhal, Abhijit, Manish Raj, Karan Singh, P. Chakraborty, and G. C. Nandi. "Path Planning through Maze Routing for a Mobile Robot with Nonholonomic Constraints."

[20]. Shukla, Jainendra, Jitendra Kumar Pal, Faimy Q. Ansari, Gora Chand Nandi, and Pavan Chakraborty. "SMART-A Social Mobile Advanced Robot Test Bed for Humanoid Robot Researchers." In Contemporary Computing, pp. 463-470. Springer Berlin Heidelberg, 2012.

[21]. Semwal, Vijay Bhaskar; Bhushan, Aparajita; Nandi, G.C., "Study of humanoid Push recovery based on experiments," Control, Automation, Robotics and Embedded Systems (CARE), 2013 International Conference on , vol., no., pp.1,6, 16-18 Dec. 2013.

[22]. Semwal, V.B.; Katiyar, S.A.; Chakraborty, P.; Nandi, G.C., "Biped model based on human Gait pattern parameters for sagittal plane movement," Control, Automation, Robotics and Embedded Systems (CARE), 2013 International Conference on , vol., no., pp.1,5, 16-18 Dec. 2013.

[23]. Wang, Shouyi, Wanpracha Chaovalitwongse, and Robert Babuska. "Machine Learning Algorithms in Bipedal Robot Control." Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on 42, no. 5 (2012): 728-743.

[24]. Gavrila, Dariu M. "The visual analysis of human movement: A survey." Computer vision and image understanding 73, no. 1 (1999): 82-98

[25]. G. Kavianand, K. Gowri Ganesh, P. Karthikeyan, "Smart child rescue system from borewell" (SCRS), Published in: Emerging Trends in Engineering, Technology and Science (ICETETS), International Conference on, 24-26 Feb. 2017.

[26]. John Jose pottery, "system for bore well rescue", Amaljothi College of engineering, vol. 10, Jun 2017.

[27]. G. Nithin, G. Gautam, G. Venkatachalam and S. Narayana "Design and stimulation of the bore-well rescue system– Advanced Asian Research Publishing Network (ARPN)" Journal of engineering and applied sciences.

[28]. N. Bourbakis and I. Papadakis-Ktistakis ATRC, "Design Ground Bio-inspired Micro-System Structure for Detecting Humans in disastrous region". Wright State University, Dayton, OH 45435 and Technical University of Crete, Greece.10th June, 2017.

[29]. Chidambaram, P. K., M. Ramachandran, Ramu Kurinjimalar, Prasanth Vidhya, and S. Sowmiya. "A Review on Phase Change Material as Energy Storage Materials." Journal: Materials and its Characterization 1, no. 1 (2022): 63-69.

[30]. K. P. Sridhar, C. R. Hema, S. Deepa Published online: "Design of a Wireless Sensor Fusion System to Analyze Conditions Inside Bore Wells". Wireless Pers Commun (2017) 94:1951–1962 DOI 10.1007/s11277-016-3299- 4 on 12 April 2016.

[31]. Chidambaram, P. K., M. Ramachandran, Vimala Saravanan, Chinnasami Sivaji, and S. Sowmiya. "A Study on Input and Response Process Parameter for Drilling Operation." Design, Modelling and Fabrication of Advanced Robots 1, no. 1 (2022): 37-42.

[32]. P.K.Chidambaram etal., " Brain with brain internet", Paishodh journal, ISSN 2347-6648,2020,Vol IX, issue III: PP 1-4. http://www.parishodhpu.com/VOLUME-9-ISSUE-3-MARCH-2020-SP/

[33]. P. Kavitha, P.K. Chidambaram etal,, 'Finger Recognition And Gesture Based Virtual Keyboard, The International journal of analytical and experimental modal analysis(IJAEMA), ISSN NO:0886-9367, Volume XII, Issue XII, December/2020,PP 1278-1292.http://www.ijaema.com/VOLUME-XII-ISSUE-XII-DECEMBER-2020/

[34]. P.K.Chidambaram, etal"Comparative Mechanical Property Analysis of Nylon6,6/ Cloisite®20A & Nylon6,6/Multiwall Nanotube Nanocomposites with Nylon6,6 , International Journal of Applied Engineering Research, ISSN 0973-4562, Volume10, No.68,2015,PP.673-676, Research India Publications. https://www.ripublication.com/ijaer.htm

[35]. Chidambaram, P. K., and R. Ramakrishanan. "Manufacturing, testing of polymer nanocomposite and analysis of tennis racket frame." International Journal of Engineering and Technology Innovation 4, no. 1 (2014): 59. 45.

[36]. Chidambaram, P. K., and R. Ramakrishanan Impact. "String Tension and Vibration Analysis of Nancomposite Based Tennis Racket Frame." Scholars Journal of Engineering and Technology (2014): 206-211.

[37]. Srividya.K, P.K.Chidambaram etal., "Pre Concentration And Analysis Of Trace Quantities of Heavy Metal Using Coirpith", Materials today proceedings, 6.3.2021

[38]. Chidambaram, P. K., Dr Amol Lokhande, Dr M. Ramachandran, M. Nathiya, and G. Mathivanan. "A study on Carbon Fiber Based Polymer Rein Force composites." REST Journal on Emerging trends in Modelling andManufacturing 7, no. 3 (2021): 94-100.

[39]. R.Vijayakothandaraman,P.K.Chidambaram, etal, 'Marine oil Separator', European journal of Molecular & Clinical Medicine,2020,Volume 7,issue 11,pages-2340-2342

[40]. P.K.Chidambaram , D.Muruganandam, "Studies on the performance of hydrokinetics riverturbines",AIP Conference Proceedings, AIP publishing,2393,020169, 1-7(2022), https://doi.org/10.1063/5.0074217

[41]. K.C.Riticka , P.K.Chidambaram , "A Review on Internet of things(IoT) and ItsApplications", SurajPunj Journal For Multidisciplinary Research , ISSN NO:2394-2886(Online),Vol.8, Issue 9, PP.79-83